CHAPTER 1
INTRODUCTION

1.1 Background

Municipal sanitary sewer collection and conveyance systems are an extensive, valuable, and complex part of the nation's infrastructure. Collection systems consist of pipelines, conduits, pumping stations, force mains, and all other facilities used to collect wastewater from individual residential, industrial, and commercial sources and convey it to facilities that provide treatment prior to discharge to the environment.

The proper functioning of these wastewater systems is among the most important factors responsible for the general level of good health enjoyed in the United States. Most members of the general public take a well-operated wastewater collection system for granted, without being aware of its design and technical workings. The public expects these systems to function effectively at a reasonable cost to ratepayers.

A large number of public and private entities may own different pipes and other components of the entire municipal sanitary sewer collection system. The customers of a municipal sanitary sewer system typically retain ownership of building laterals and are responsible for their maintenance. However, municipalities can have differing regulations pertaining to lateral ownership. These regulations should be revised on a case-by-case basis and incorporated into any management plan. In addition, commercial complexes, homeowner associations, and other entities may retain ownership of collector sewers leading to the municipal sanitary sewer system. In some situations, the municipality that owns the collector sewers may not provide treatment of wastewater, but only convey its wastewater to a collection system that is owned and operated by a different municipal entity. Collection systems of this nature are referred to as *satellite collection systems.*

According to the Environmental Protection Agency (EPA), of the more than 19,000 collection systems, about 4,800 are satellite collection systems. There are also private satellite collection systems, which are associated with a wide range of entities such as trailer parks, residential subdivisions, apartment complexes, commercial complexes such as shopping centers, industrial parks, college campuses, and military facilities.

EPA estimates that the more than 19,000 collection systems in the U.S. would have a replacement value of $1 trillion to $2 trillion dollars. Another source estimates that wastewater treatment and collection systems represent about 10 – 15 percent of the total infrastructure value in the U.S. The collection system of a single large municipality can represent an investment worth billions of dollars. Usually, the asset value of the collection system is not fully recognized and the collection system operation and maintenance programs are given low priority compared with wastewater treatment needs and other municipal responsibilities.

The current performance of many collection systems is poor and many systems have received minimal maintenance for many years. Many collection systems are maintained by a public works department charged with various functions, such as street, sidewalk, storm drain, and sometimes water utility maintenance. Money is usually spent where the ratepayer can see the results.

Wastewater collection systems also suffer from a history of inadequate investment in maintenance and repair often due in large part to the "out-of-sight, out-of-mind" nature of the wastewater collection system which poses an inherent problem.

The lack of proper maintenance has resulted in deteriorated sewers with subsequent basement backups, overflows, cave-ins, hydraulic overloads at treatment plants, and other safety, health, and environmental problems. As one of the most serious and environmentally threatening problems, *sanitary sewer overflows*—or *SSOs*—are a frequent cause of water quality violations and are a threat to public health and the environment. Beach closings, flooded basements, closed shellfish beds, and overloaded treatment plants are some symptoms of collection systems with inadequate capacity and improper management, operation, and maintenance.

The poor performance of many sanitary sewer systems and resulting potential health and environmental risks highlight the need to optimize operation and maintenance of these systems.

1.2 Brief History of Collection System Regulatory Activities

EPA has been working for a number of years on enhancing existing regulations to reduce or eliminate the occurrence of SSOs and preserve the substantial investment in infrastructure that collection systems represent. In 1995, EPA convened an Urban Wet Weather Flows Advisory Committee and an SSO Subcommittee. Both the Committee and the Subcommittee included municipal representatives, advocacy groups, states, and EPA. The SSO Subcommittee examined the need for national consistency in permitting and enforcement, effective sewer operation and maintenance principles, public notification of SSOs with potential health and environmental dangers, and other public policy issues.

On May 29, 1999, President Clinton directed EPA to "improve protection of public health at our Nation's beaches by developing, within one year, a strong national regulation to prevent the over 40,000 annual sanitary sewer overflows from contaminating our nation's beaches and jeopardizing the health of our nation's families. At a minimum, the program must raise the standard for sewage treatment to adequately protect public health and provide full information to communities about water quality problems and associated health risks caused by sanitary sewer overflows."

EPA Administrator Carol Browner signed a proposed SSO rule in January 2001. The incoming Bush Administration withdrew the signed rule proposal for further review before it could be officially published in the Federal Register for public comment. The draft of the never-proposed SSO regulation was made available on EPA's website and stakeholders provided EPA with extensive comment despite the absence of a formal comment period.

The draft proposed regulation included three major provisions related to controlling SSOs:

Standard Permit Conditions

Standard permit conditions would address:

- Record keeping and reporting requirements for SSOs.
- Public notification requirements for SSOs.
- Capacity assurance, management, operation, and maintenance requirements for municipal sanitary sewer collection systems.
- Prohibition of SSO discharges to waters of the United States.

Municipal Satellite Collection Systems

The proposed regulation addressed the need for satellite systems to obtain NPDES permit coverage. Satellite systems are collection systems that do not treat and discharge their wastewater. Rather, they convey flows to a treatment facility where the NPDES permittee is a different entity.

Emergency Overflow Structures

The regulation provides criteria for evaluating the location of constructed emergency overflow structures for collection systems.

Although EPA has indicated its intent to propose the January 2001 regulatory text with a revised preamble, as of the release of this guidance document, the proposal has not occurred and EPA has set no timetable for the rule's release.

It is worth noting that current regulatory language of the Clean Water Act pertaining to the National Pollutant Discharge Elimination System (NPDES) program, contained in 40 CFR 122.41(e), states: "The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit." This provision applies to collection systems operated by municipalities with their own treatment works, but not public or private satellite collection systems.

1.3 Brief Discussion of Types of Maintenance Activities

The purpose of operation and maintenance (O&M) programs is to maintain design functionality (capacity and integrity) and/or to restore the system components to the original condition and thus functionality. The ability to effectively operate and maintain a wastewater collection system so it performs as intended depends greatly on site conditions, proper design (including selection of appropriate materials and equipment), construction and inspection, testing and acceptance, and system start-up. This is true for both the collection system and the system laterals and service connections.

O&M staff should be involved at the beginning of each project, including planning, design, construction, acceptance and start-up. When a collection system is designed with future O&M considerations in mind, the result is a more effective program in terms of O&M cost and performance.

Wastewater system maintenance can be either a proactive or reactive activity. Effective O&M programs are based on knowing what components make up the system, where they are located, and the condition of the components. With that information, proactive maintenance can be planned and scheduled, rehabilitation needs identified, and long-term Capital Improvement

Programs (CIPs) planned and budgeted. High-performing agencies have all developed performance measurements of their O&M program and track the information necessary to evaluate performance.

> Capital improvement programs often follow a *capital improvement plan.* The Association of Metropolitan Sewerage Agencies (AMSA) has a document titled *Managing Public Infrastructure Assets to Minimize Cost and Maximize Performance* (available—for a fee—at: *www.amsa-cleanwater.org*), which contains the following definition:
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> **CIP- capital improvement plan** - A plan for expenditures taking into consideration the fundamental strategic goals for a utility system, including growth, expansion, renewal and replacement, regulatory compliance, and stakeholder service needs. Typically, CIP documents show the projected annual expenditures by project and category for at least five years. Increasingly, utilities are extending their CIP documents to 10-20 year time frames and including projected sources of revenue where available. Traditionally, CIPs have been updated on a regular cycle, such as once per year or every other year. Some agencies have begun the practice of updating their CIP documents on a continuous basis and posting the current CIP on either intranet or Internet sites.

Commonly accepted types of maintenance include three classifications: *corrective maintenance, preventive maintenance, and predictive maintenance.*

1.3.1 Corrective Maintenance

Maintenance classified as corrective, including emergency maintenance, is reactive. Only when the equipment or system fails is maintenance performed. Reliance on reactive maintenance will always result in poor system performance, especially as the system ages.

A corrective maintenance approach is characterized by:

- The inability to plan and schedule work.
- The inability to budget adequately.
- Poor use of resources.
- A high incidence of equipment and system failures.

Emergency maintenance involves two types of emergencies: normal emergencies and extraordinary situations. Normal emergencies can happen on a daily basis whether it is a pipe break or a blockage in a sewer. An effective maintenance program can reduce normal emergencies. Extraordinary emergencies, such as high-intensity rainstorms, hurricanes, floods, and earthquakes, will always be unpredictable occurrences. However, the effects of extraordinary emergencies on the system's performance can be minimized by implementation of a planned maintenance program and development of a comprehensive emergency response plan.

1.3.2 Preventive Maintenance

Maintenance classified as preventive is proactive and is defined by a programmed, systematic approach to maintenance activities. This type of maintenance will always result in improved system performance except in the case where major chronic problems are the result of design and/or construction flaws that cannot be completely corrected by O&M activities. Proactive maintenance is performed on a periodic (preventive) basis or an as-needed (predictive) basis. Preventive maintenance can be scheduled on the basis of specific criteria such as known problem areas (for example—a siphon that often gets clogged, a low point that is often first to overflow in a storm event, or even an area prone to blockages), equipment operating time since the last maintenance was performed, or passage of a certain amount of time (calendar period).

The major elements of a good preventive and predictive maintenance program include the following:

- Planning and scheduling.
- System mapping/GIS.
- Computerized maintenance program.
- Records management.
- Assets inventory and management.
- Spare parts management.
- Cost and budget control.
- Emergency repair procedures.
- Training program.

Some benefits of taking a preventive maintenance approach are:

- Maintenance can be planned and scheduled.
- Work backlog can be identified.
- Adequate resources necessary to support the maintenance program can be budgeted.
- Capital Improvement Program (CIP) items can be identified and budgeted for.
- Human and material resources can be used effectively.

1.3.3 Predictive Maintenance

The third type of maintenance is predictive. Predictive maintenance, which is also proactive, is a method of establishing baseline performance data, monitoring performance criteria over a period of time, and observing changes in performance so that failure can be predicted and maintenance can be performed on a planned, scheduled basis.

System performance is frequently a reliable indicator of how the system is operated and maintained. Agencies that historically relied primarily on corrective maintenance as their method of operating and maintaining the system are never able to focus on preventive and predictive maintenance since most of their resources are directed at corrective

In reality, every agency operates their system using some combination of corrective and emergency maintenance, preventive maintenance, and predictive maintenance methods. The goal, however, should be to reduce the corrective and emergency maintenance efforts by performing preventive maintenance that will minimize or even eliminate system failures that result in stoppages and overflows.

maintenance activities and it is difficult to free up these resources to begin developing preventive maintenance programs.

The goal of managing maintenance is to minimize investments of labor, materials, money, and equipment. In other words, we want to manage our human and material resources as effectively as possible, while delivering a high level of service to our customers.

The benefits of an effective operation and maintenance program are as follows:

- Ensuring the availability of facilities and equipment as intended.
- Maintaining the reliability of the equipment and facilities as designed. Utility systems are required to operate 24 hours per day, 7 days per week, and 365 days per year. Reliability is a critical component of the operation and maintenance program. If equipment and facilities are not reliable, then the ability of the system to perform as designed is impaired.
- Maintaining the value of the investment. Wastewater systems represent major capital investments for communities and are major capital assets of the community. If maintenance of the system is not managed, equipment and facilities will deteriorate through normal use and age. Maintaining the value of the capital asset is one of the utility manager's major responsibilities. Accomplishing this goal requires ongoing investment to maintain existing facilities and equipment and extend the life of the system, and establishing a comprehensive O&M program.
- Obtaining full use of the system throughout its useful life.
- Collecting accurate information and data on which to base the operation and maintenance of the system and justify requests for the financial resources necessary to support it.
- Costs. Planned maintenance and repairs are much more cost effective both in the long and short term because the work can be done with the proper materials during normal working hours and under preferred working conditions. Repairing a pipe break in the middle of night during freezing rain with the wrong materials, while paying time and a half for labor can not only increase cost manyfold but produce a substandard repair and leave the consumer without service for an unnecessarily long time.

1.4 Role of the Collection System Owner/Operator/Manager

A collection system manager's specific O&M responsibilities vary depending on the size of the utility. At a small utility, the manager may oversee all utility operations (water and wastewater) while also serving as chief operator and supervising a small staff of operations and maintenance personnel and administrative personnel. In larger utility agencies, the manager may have no direct, day-to-day responsibility for operations and maintenance but is ultimately responsible for efficient, cost-effective operation of the entire utility and customer satisfaction.

CHAPTER 1 REFERENCES:

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